

**What is claimed is:**

- 1                   1. A method of voice activity detection comprising:  
2                   determining a difference between (a) an average ratio of  
3                   energy above a first threshold frequency in a signal comprising multiple  
4                   frequencies and energy below the first threshold frequency in the signal  
5                   and (b) a present ratio of energy above the first threshold frequency in the  
6                   signal and energy below the first threshold frequency in the signal; and  
7                   in response to the difference either being exceeded by a first  
8                   threshold value or exceeding a second threshold value greater than the  
9                   first threshold value, indicating that the signal includes a voice signal.
- 1                   2. The method of claim 1 wherein:  
2                   the first threshold frequency is about 2400 Hz.
- 1                   3. The method of claim 1 further comprising:  
2                   prior to the determining, removing noise energy from the signal.
- 1                   4. The method of claim 3 wherein:  
2                   removing comprises  
3                   filtering out from the signal frequencies below a second  
4                   threshold frequency lower than the first threshold frequency.
- 1                   5. The method of claim 4 wherein:  
2                   the second threshold frequency is about 100 Hz.
- 1                   6. The method of claim 1 further comprising:  
2                   repeating the steps for successive segments of the signal.
- 1                   7. The method of claim 1 further comprising:  
2                   determining an average periodicity of the signal; and  
3                   in response to the average periodicity of the signal being lower

4 than a third threshold value, indicating that the signal includes a voice  
5 signal.

1 8. The method of claim 7 wherein:  
2 determining an average periodicity comprises  
3 estimating a pitch period of the signal;  
4 determining a gain value of the signal over the pitch period as a  
5 function of the estimated pitch period;  
6 determining a periodicity of the signal over the pitch period as a  
7 function of the estimated pitch period and the gain value; and  
8 averaging the determined periodicity with previously-  
9 determined at least one said determined periodicity.

1 9. The method of claim 7 further comprising:  
2 repeating the steps for successive segments of the signal.

1 10. The method of claim 7 further comprising:  
2 determining a difference between average total energy in the  
3 signal and present total energy in the signal; and  
4 in response to the difference between the average total energy  
5 and the present total energy being lower than a fourth threshold value and  
6 the average periodicity of the signal being lower than a fifth threshold  
7 value, indicating that the signal includes a voice signal.

1 11. The method of claim 10 further comprising:  
2 prior to determining the difference between the average total  
3 energy and the present total energy, removing noise energy from the  
4 signal.

1 12. The method of claim 1 wherein:  
2 determining a difference between the average total energy and

3 the present total energy comprises  
4 determining a difference between average total energy in a  
5 voiceband of the signal and present total energy in the voiceband.

1 13. The method of claim 12 wherein:  
2 the voiceband extends from about 100 Hz to about 4000 Hz.

1 14. The method of claim 10 further comprising:  
2 repeating the steps for successive segments of the signal.

1 15. The method of claim 14 further comprising:  
2 in response to not indicating for a present segment of the signal  
3 that the signal includes a voice signal, and indicating for a segment of the  
4 signal preceding the present segment that the signal includes a voice  
5 signal, determining if the average total energy of the signal exceeds a  
6 minimum average total energy of the signal by a sixth threshold value; and  
7 in response to the average total energy exceeding the minimum  
8 average total energy by the sixth threshold value, indicating that the signal  
9 includes a voice signal.

1 16. An apparatus that performs the method of any one of the  
2 claims 1-15.

1 17. A computer-readable medium containing executable  
2 instructions which, when executed in a computer, cause the computer to  
3 perform the method of any one of the claims 1-15.

1 18. An apparatus for detecting voice activity comprising:  
2 means for determining an average ratio of energy above a first  
3 threshold frequency in a signal comprising multiple frequencies and  
4 energy below the first threshold frequency in the signal;

5 means for determining a present ratio of energy above the first  
6 threshold frequency in the signal and energy below the first threshold  
7 frequency in the signal;

8 means for determining a difference between the average ratio  
9 and the present ratio; and

10 means cooperative with the means for determining a difference  
11 and responsive to the difference either being exceeded by a first threshold  
12 value or exceeding a second threshold value greater than the first  
13 threshold value, for indicating that the signal includes a voice signal.

1 19. The apparatus of claim 18 further comprising:

2 means for determining an average periodicity of the signal; and

3 means cooperative with the means for determining an average  
4 periodicity and responsive to the average periodicity being lower than a  
5 third threshold value, for indicating that the signal includes a voice signal.

1 20. The apparatus of claim 19 further comprising:

2 means for determining a difference between average total  
3 energy in the signal and present total energy in the signal; and

4 means cooperative with the means for determining a difference  
5 between the average total energy and the present total energy and the  
6 means for determining an average periodicity and responsive to the  
7 difference between the average total energy and the present total energy  
8 being lower than a fourth threshold value and the average periodicity of  
9 the signal being lower than the fifth threshold value, for indicating that the  
10 signal includes a voice signal.

1 21. The apparatus of claim 20 for detecting voice activity in  
2 successive segments of the signal, further comprising:

3 means responsive to a lack of indication for a present segment

4 of the signal that the signal includes a voice signal and to an indication for  
5 a segment of the signal preceding the present segment that the signal  
6 includes a voice signal, for determining if the average total energy of the  
7 signal exceeds a minimum average total energy of the signal by a sixth  
8 threshold value; and

9 means cooperative with the means for determining of the  
10 average total energy exceeds the minimum average total energy and  
11 responsive to the average total energy exceeding the minimum average  
12 total energy by the sixth threshold value, for indicating that the signal  
13 includes a voice signal.